



Available online at [www.sciencedirect.com](http://www.sciencedirect.com)

ScienceDirect

journal homepage: [www.e-jds.com](http://www.e-jds.com)



Original Article

# Modified envelope flap, a novel incision design, can relieve complications after extraction of fully horizontal impacted mandibular third molar



Qingtiao Xie, Shanliang Wei, Nuo Zhou\*, Xuanping Huang\*\*

Department of Oral and Maxillofacial Surgery, Guangxi Medical University College of Stomatology, Nanning, China

Received 2 January 2020; Final revision received 18 June 2020  
Available online 18 September 2020

## KEYWORDS

Modified envelope flap;  
Impacted mandibular third molars;  
Complications

**Abstract** *Background/purpose:* Patients always suffer from dental extraction complications of fully horizontal impacted mandibular third molar, such as pain, swelling and limited mouth opening. A novel incision, modified envelope flap (MEF), was designed to alleviate the complications through minimizing the tissue injury during this surgery procedure.

*Materials and methods:* With indications of removing bilateral fully horizontal impacted mandibular the third molars, 40 patients were recruited and received dental extraction under incision with modified envelope flap (MEF) in one lateral and modified triangular flap (MTF) in the other lateral respectively. MEF incision was made along the buccal gingival sulcus from mesial to distal of the mandibular second molar with an extension to retromolar trigone at 45° inclination. As a control, traditional incision MTF was made starting with a vertical incision at the mesial buccal gingiva of the mandibular second molar with extension as MEF. Fully horizontal impacted mandibular third molar were extracted successfully. Surgery time and post-operative pain, swelling and mouth opening were recorded at day 1, 3, 7.

*Results:* There was no significant difference of the surgery time, pain, swelling (day 1) and mouth opening (day1) between MEF and MTF group ( $p > 0.05$ ). However, the scores of swelling (day 3, 7) and mouth opening (day3, 7) of MEF group were much lower than that of MTF group ( $p < 0.05$ ), indicating attenuated complications and quicker recovery.

*Conclusion:* With small injury, MEF hasn't prolong the surgery time but relieves complications after extraction of fully horizontal impacted mandibular third molar and might be a promising method compared with MTF.

\* Corresponding author. Fax: +86(0771)5315946.

\*\* Corresponding author. Fax: +86(0771)5315946.

E-mail addresses: [nuozhou@hotmail.com](mailto:nuozhou@hotmail.com) (N. Zhou), [hxp120@126.com](mailto:hxp120@126.com) (X. Huang).

## Introduction

Potential complications of the surgical removal of impacted tooth, such as pain, swelling, limited mouth opening, dry socket, wound dehiscence, and even lingual nerve damage occur commonly due to injury, excessive bleeding and prolonged surgery during the operation.<sup>1–4</sup> The incidence of these complications has been reported to 6.9% and may be related to host-related factors, age (over the age of 24 years), sex (more common in females than males), smoking, oral hygiene, general health and surgeon skills.<sup>5</sup> Mucoperiosteal flap raising and ostectomy during the extraction procedures of fully horizontal impacted mandibular third molar make patients more vulnerable to postoperative complications.

Managements have been implemented to reduce post-operative complications of fully horizontal impacted mandibular third molars extraction. Absorbable gelatin sponge significantly decreased postoperative bleeding and swelling.<sup>6</sup> Platelet-rich fibrin (PRF) appeared to reduce postoperative pain and swelling and low-concentration povidone iodine caused a significant decrease in swelling and trismus.<sup>7,8</sup> However, expensive fees or potential anaphylaxis limited these biologicals applications. As for incision design, plenty kinds of flaps have been discussed such as envelope flap, triangular flap and other modified flaps.<sup>9,10</sup> The traditional incision for removing fully horizontal impacted mandibular third molar is modified triangular flap (MTF). MTF starts with a vertical incision at the mesial buccal gingiva of the mandibular second molar and forms a trapezoid flap. A fully visual operative field was obtained after MTF incision for tooth extraction. However, complications, such as pain, swelling, bleeding and limited mouth opening were common consequents and seems unavoidable.

To optimize clinical outcomes and quality of life for patients, perfection surgical design, a modified envelope flap (MEF) was implemented for tooth extraction. In the clinical practice, fully surgical field view was obtained though without the mesiobuccal incision as MTF. But the definite superiority of MEF was unknown. Hence, we investigate the application of MEF for fully horizontal impacted mandibular third molars extraction by valuing its postoperative complications (pain, swelling and trismus) compared with MTF.

## Materials and methods

The surgery options were agreed in writing by the patients, and all procedures were approved by Guangxi Medical University Affiliated Stomatology Hospital Ethical Committee. This was a randomized single-blinded, split-mouth study. All post-operative examinations and surveys were

carried out by an oral and maxillofacial surgeon who do not know the details of the study design.

## Details of patients

40 patients were recruited from Guangxi Medical University College of Stomatology from Jan. 1st, 2018 to Dec. 31st, 2018. 18–32 years old, 18 males (50–70 kg), 22 females (40–60 kg) were included. All the patients were diagnosed with bilateral impacted mandibular third molars. According to cone beam computed tomography (Fig. 1), all the impacted teeth were classified as horizontal impaction and the crowns were on the mesial. The inclusion criteria were patients without systemic disease, using medications, poor oral hygiene, compromised dental, periodontal status, smoking habit, allergy or contraindications to drugs, pregnancy and a noticeable local inflammation or pathology in the oral cavity that would influence the surgical procedure or postoperative wound healing.

## Surgical procedure

The left and right sight impacted teeth of one patient were randomly assigned into MEF and MTF groups. MEF sides were obtained operation firstly and MTF sides' teeth were extracted 4 weeks later. All the operations were performed by the same surgeon and the evaluating data were collected by another doctor.

Before surgery, the surgeon read the panoramic radiograph to understand the shape of the root, relationship between the roots and the nerve. Gargling for 2 min with 15 ml compound chlorhexidine water and inferior alveolar nerve block was performed by injecting lidocaine 2% (Harvest Pharmaceutical Co. Ltd., Shanghai, China) 5 ml with epinephrine (Grandparma Co. Ltd., Wuhan, China) 1:100 000 in it.

## Modified envelope flap (MEF) group

A gingival sulcus incision was made form mesial side of the mandibular second molar to the distal surface of the



**Figure 1** Bilateral symmetrically fully horizontal impacted mandibular third molars on panoramic radiograph.

distobuccal cusp in the mandibular second molar, then the incision was extended 45° obliquely to the mandibular ramus. The mucoperiosteal flap was raised up to exposing the bone. Osteotomy then was underwent using a surgical handpiece (NSK, Nakanishi Inc., Tokyo, Japan) and a round bur with normal sterile saline washing simultaneously to expose the crown. After the crown was separated to the root, the crown was sectioned into two parts. The crown and the roots were extracted separately with the help of an elevator. The alveolar fossa was cleaned with normal sterile saline clearly and the mucoperiosteal flap was replaced. Finally, the wound was closed with simple, interrupted stitches with 4–0 nonabsorbable silk thread (Fig. 2).

#### Modified triangular flap (MTF) group

A vertical incision was made on the mesiobuccal gum of the mandibular second molar (no extension over the mucogingival junction), then the incision was extended along the gingival sulcus to the disobuccal corner of the second molar and continued the incision 45° obliquely to the mandibular ramus. Finally, the rest of the procedure went on as described above (Fig. 2).

#### Data collection

All patients were given metronidazole (400mg/8 h) for 2 days. Surgery time and pain, swelling, trismus of day 1, 3, 7 were recorded. **Surgery time** (minutes): from the incision was cut to the suture finished. **Pain**: according to the

standard verbal rating scale (VAS), 1: no pain, 2: slight pain, 3: moderate pain, 4: severe pain.<sup>11</sup> **Swelling**: using visual measurement: Degree I: no swelling or slightly on observing carefully, Degree II: moderate swelling, Degree III: severe swelling. **Mouth opening**: it was recorded by measuring the distance (cm) between the upper and the lower central incisal margin.

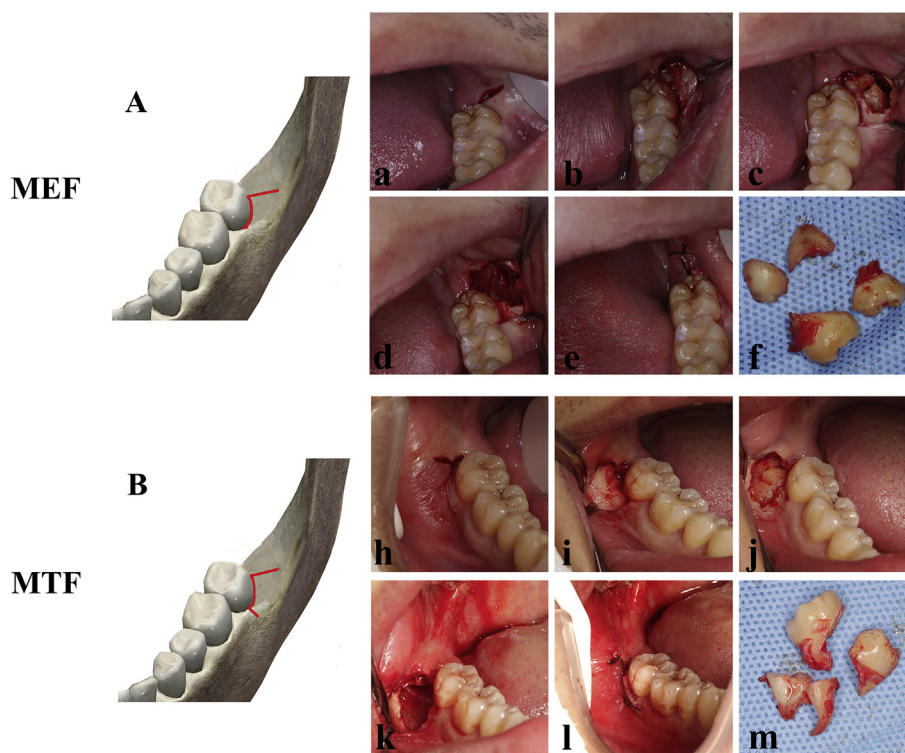
#### Statistical processing

All data were analyzed by SPSS (SPSS Inc., Chicago, IL, USA). The data of surgery time and mouth opening were presented as mean ± standard deviation and further processed by paired t-test. Data of pain, swelling was processed using wilcoxon rank sum test. All data. Statistical differences were performed by one-way analysis of variance (ANOVA). A value of  $p < 0.05$  was considered statistically significant.

#### Results

All the 40 patients accepted bilateral impacted mandible third molar extraction successfully and they all followed up day 1, 3, 7's measurement. There were no significant differences in surgery time (Table 1) and postoperative pain (Table 2) between MEF group and MTF group.

Results of postoperative swelling (Table 3) showed that there were no significant differences in day 1 between MEF and MTF group ( $p > 0.05$ ). However, in day 3, the cases of III degree swelling in MEF were much less than that in MTF



**Figure 2** A: The graph of modified envelope flap (MEF) and the surgical procedure (from a to f) of it were showed. B: The graph of modified triangular flap (MTF) and the surgical procedure (from h to m) of it were showed.

**Table 1** Comparison of surgery time (minutes) between MEF group and MTF group.

	MEF	MTF
	13.9 ± 1.5 (mins)	14.5 ± 1.8 (mins)
<i>p</i> value	0.087	

MEF: modified envelope flap; MTF: modified triangular flap.  
\* Significant level  $p < 0.05$ .

**Table 2** Comparison of postoperative pain between MEF group and MTF group.

Degree	Day 1 (cases)		Day 3 (cases)		Day 7 (cases)	
	MEF	MTF	MEF	MTF	MEF	MTF
1	2	4	20	18	33	28
2	8	6	16	15	7	11
3	21	28	4	5	0	1
4	9	12	0	2	0	0
<i>p</i> value	0.733		0.345		0.157	

MEF: modified envelope flap; MTF: modified triangular flap.  
\* Significant level  $p < 0.05$ .

**Table 3** Comparison of postoperative swelling between MEF group and MTF group.

Degree	Day 1 (cases)		Day 3 (cases)		Day 7 (cases)	
	MEF	MTF	MEF	MTF	MEF	MTF
I	4	3	10	7	27	23
II	18	21	24	21	12	18
III	18	16	6	12	0	0
<i>p</i> value	0.564		0.003		0.014	

MEF: modified envelope flap; MTF: modified triangular flap.  
\* Significant level  $p < 0.05$ .

group. Similarly, cases of II degree swelling in MEF were also less on day 7 ( $p < 0.05$ ). These results indicating that the swelling degree in MEF group was much mild than that in MTF group.

In accordance with the results of postoperative swelling (Table 4), no significant differences were observed in postoperative mouth opening between MEF and MTF group in day 1 ( $p > 0.05$ ). But the postoperative mouth opening in

MEF group in day 3 and day 7 were distinctly larger than that in MTF group ( $p < 0.05$ ).

## Discussion

In this clinical trial, MEF incision design exhibits similarly efficiency in surgery time as MTF for dental extraction and relieves postoperative swelling and facilitates mouth opening in day 3, 7, though has no beneficial for pain, which suggested that MEF can shorten the healing period comparing with MTF.

Without the vertical incision in the mesiobuccal gum of the mandibular second molar, a traditional design in MTF, MEF flap decrease the suture difficulty and relieve the postoperative swelling and mouth opening for fully horizontal impacted mandibular third molars. Flap designs play a very important role in impacted mandibular third molars extraction.<sup>12,13</sup> An excellent incision provides enough surgery vision for osteotomy and dividing tooth. Yolcu U et al. introduced a new flap with lingual base and compare this flap to the triangular flap technique.<sup>9</sup> They got a better healing with the new flap as the suture line does not lie over the socket area and there was less wound dehiscence and potential for infection with this alternative flap, but postoperatively there was initially greater pain. Comparing to envelop flaps, Mohajerani, H found that MTF reduced incidence of dry socket and decreased healing period after mandibular impacted wisdom molar surgery due to the lower area of MTF and that the oral tissues are disturbed to a minor extent.<sup>14</sup> But Dogan Dolanmaz's trial showed that there were no significant differences between the envelope flap and the MTF regarding the hematoma rates and postoperative pain, swelling.<sup>10</sup> As for the two conventional flaps, Baqain, Z H found that facial swelling and the reduction in mouth opening were significantly greater in the early postoperative period with triangular flap design.<sup>15</sup> MEF, also named as MPMI flap by Elo et al., was associated with decreased odds of wound dehiscence and infection compared to MTF and traditional EF (envelope flap), but the swelling and mouth opening after teeth extraction had not been studied.<sup>2</sup> The attenuation of postoperative swelling and mouth opening in MEF design might be attribute to a smaller injury and more perfect reposition of gingival flaps than MTF.

With shorter practice time but small injury, MEF design was as efficient as the traditional flap MTF for removing of fully horizontal impacted mandibular third molars. In addition, MEF relieves complications after extraction of fully horizontal impacted mandibular third molar and might be a promising technical alternative for busy surgeons.

**Table 4** Comparison of postoperative mouth opening between MEF and MTF group (cm, mean ± SD).

Groups	Day 1		Day 3		Day 7	
	MEF	MTF	MEF	MTF	MEF	MTF
	2.3 ± 0.6	2.1 ± 0.8	2.9 ± 0.4	2.4 ± 0.8	3.3 ± 0.3	2.7 ± 0.5
<i>p</i> value	0.417		<0.001		<0.001	

MEF: modified envelope flap; MTF: modified triangular flap.  
\* Significant level  $p < 0.05$ .

## Declaration of Competing Interest

The authors have no conflicts of interest relevant to this article.

## Acknowledgments

This work has been financially supported by Guangxi Clinical Research Center for Craniofacial Deformity (AD17129004), Guangxi Natural Science Foundation (Grant No. 2018GXNSFBA050043), Research and Development Projects of Appropriate Technologies for Medical and Health Care in Guangxi (S201411-01) and Self-funded Scientific Research Project of Guangxi Zhuang Autonomous Region Health Department (Z2014092, Z20180123).

## References

1. Kirk DG, Liston PN, Tong DC, et al. Influence of two different flap designs on incidence of pain, swelling, trismus, and alveolar osteitis in the week following third molar surgery. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2007;104:e1–6.
2. Elo JA, Sun HH, Dong F, et al. Novel incision design and primary flap closure reduces the incidence of alveolar osteitis and infection in impacted mandibular third molar surgery. *Oral Surg Oral Med Oral Pathol Oral Radiol* 2016;122:124–33.
3. Quee TA, Gosselin D, Millar EP, et al. Surgical removal of the fully impacted mandibular third molar. The influence of flap design and alveolar bone height on the periodontal status of the second molar. *J Periodontol* 1985;56:625–30.
4. Walters H. Reducing lingual nerve damage in third molar surgery: a clinical audit of 1350 cases. *Br Dent J* 1995;178:140–4.
5. Blondeau F, Daniel NG. Extraction of impacted mandibular third molars: postoperative complications and their risk factors. *J Can Dent Assoc* 2007;73:325.
6. Kim JC, Choi SS, Wang SJ, et al. Minor complications after mandibular third molar surgery: type, incidence, and possible prevention. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2006;102:e4–11.
7. Canellas J, Ritto FG, Medeiros PJD. Evaluation of postoperative complications after mandibular third molar surgery with the use of platelet-rich fibrin: a systematic review and meta-analysis. *Int J Oral Maxillofac Surg* 2017;46:1138–46.
8. Mahmoud Hashemi H, Mohammadi F, Hasheminasab M, et al. Effect of low-concentration povidone iodine on postoperative complications after third molar surgery: a pilot split-mouth study. *J Oral Maxillofac Surg* 2015;73:18–21.
9. Yolcu U, Acar AH. Comparison of a new flap design with the routinely used triangular flap design in third molar surgery. *Int J Oral Maxillofac Surg* 2015;44:1390–7.
10. Dolanmaz D, Esen A, Isik K, et al. Effect of 2 flap designs on postoperative pain and swelling after impacted third molar surgery. *Oral Surg Oral Med Oral Pathol Oral Radiol* 2013;116:e244–6.
11. Jang YH, Kim SM, Eun DH, et al. Validity and reliability of itch assessment scales for chronic pruritus in adults: a prospective multicenter study. *J Am Acad Dermatol* 2020;82:80–6.
12. Coulthard P, Bailey E, Esposito M, et al. Surgical techniques for the removal of mandibular wisdom teeth. *Cochrane Database Syst Rev* 2014:CD004345.
13. Chen YW, Lee CT, Hum L, et al. Effect of flap design on periodontal healing after impacted third molar extraction: a systematic review and meta-analysis. *Int J Oral Maxillofac Surg* 2017;46:363–72.
14. Mohajerani H, Esmaelinejad M, Jafari M, et al. Comparison of envelope and modified triangular flaps on incidence of dry socket after surgical removal of impacted mandibular third molars: a double-blind, split-mouth study. *J Contemp Dent Pract* 2018;19:836–41.
15. Baqain ZH, Al-Shafii A, Hamdan AA, et al. Flap design and mandibular third molar surgery: a split mouth randomized clinical study. *Int J Oral Maxillofac Surg* 2012;41:1020–4.